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ABSTRACT

Recognizing the underrepresentation and poor academic performance of Mexican American students in mathematics- and science-based fields, the guide (1) reviews student- and institution-related factors contributing to mathematics and science declines, (2), describes selective secondary and college mathematics and science model programs, (3) identifies and describes organizational components of mathematics and science models, and (4) identifies key elements which contribute to successful models. Poverty, poor high school achievement, lack of encouragement, and poor math and science facilities and materials are identified as barriers to Mexican American participation. The models described are available for replication and target precollege students (11 models), community college students (1 model), and four-year college students (2 models). Key elements and organizational components of successful mathematics and science program models discussed include school/college mission, math/science departmental policies and objectives, organizational design, program staffing, type and level of students targeted, curriculum focus, program funding, program evaluation, and student outcomes. The guide includes how-to-do-it suggestions for planning, organizing, and staffing mathematics models. Practical recommendations suggest ways teachers, counselors, administrators, and parents can facilitate the implementation of mathematics and science models and encourage Mexican American students to develop interest in these fields. (NEC)

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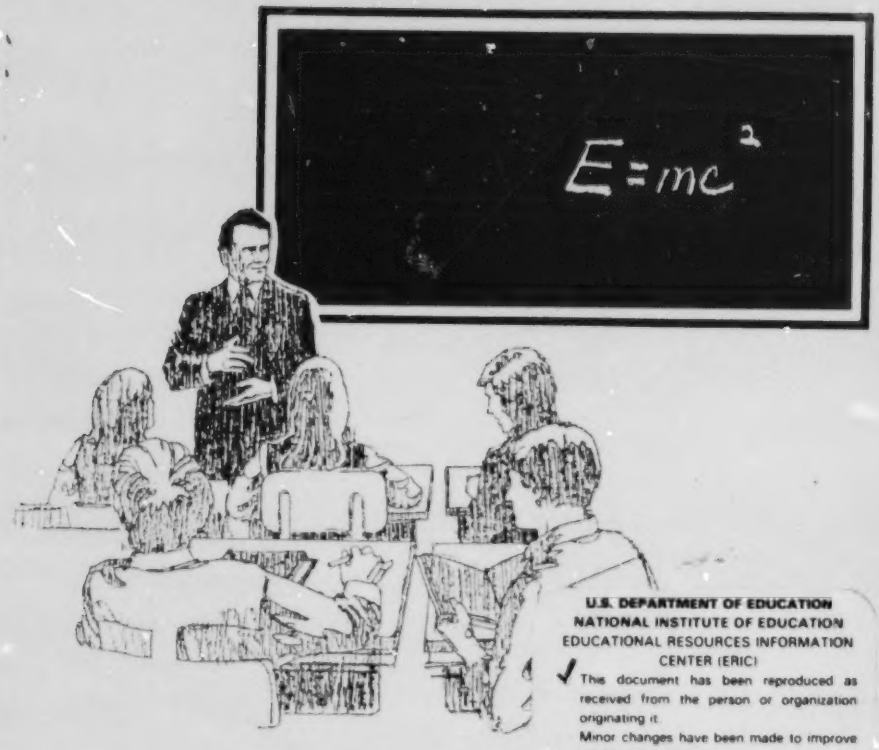

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A Guide for Developing School & College Intervention Models

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PREPARING MEXICAN AMERICANS FOR MATHEMATICS- AND SCIENCE-BASED FIELDS: A GUIDE FOR DEVELOPING SCHOOL AND COLLEGE INTERVENTION MODELS

by

Laura I. Rendón

1985

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PREFACE

Although Mexican Americans comprise the largest subgroup of Hispanics, their participation in mathematics and science school and college programs and related professions is virtually nonexistent. Obstacles which restrict their access to mathematics and science programs and professions and limit their achievement in these fields include such student- and institution-related barriers as poverty, poor high school achievement, lack of encouragement, and poor facilities and materials available in these fields. Intervention projects to alleviate this underrepresentation of trained Mexican American mathematicians and scientists have recently been established at the secondary and postsecondary levels. These projects provide Mexican American students an opportunity to participate in programs which will train them for professions in mathematics, science, and technology-based fields.

Given the underrepresentation and poor academic performance of Mexican American students in these fields, this guide provides teachers, counselors, administrators, and parents at the school and college level with practical how-to-do-it suggestions for encouraging Mexican American students to become interested in and to succeed in science and mathematics programs. As past Director of the Border College

Consortium Math Intervention Project, Dr. Laura Rendón is particularly qualified to provide guidance in this area. That Ford Foundation-funded project included the six community colleges of the Consortium--all of which are located along the 2,000-mile United States-Mexico border. In addition, Dr. Rendón is the author of numerous other publications pertaining to Hispanic students in mathematics and science courses.

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SUMMARY

Given the underrepresentation and poor academic performance of Mexican American students in mathematics- and science-based fields, this guide provides information about barriers related to access and achievement in these fields and includes models and strategies that institutions can use to improve student participation and retention. The guide includes (1) a review of student- and institution-related factors contributing to mathematics and science declines, (2) a description of selective school and college mathematics and science model programs, (3) the identification and description of organizational components of mathematics and science models, and (4) the identification of key elements which contribute to successful models. The guide includes how-to-do-it suggestions for planning, organizing, and staffing mathematics and science models. Practical recommendations suggest ways teachers, counselors, administrators, and parents can facilitate the implementation of mathematics and science models and encourage Mexican American students to develop an interest in these fields.

INTRODUCTION

The state of mathematics and science education for Mexican American students is currently in jeopardy. As a group, Hispanics comprised about 6.4 percent of the United States population in 1980 ("Hispanic Population at 16 Million," 1984). Mexican Americans make up the largest Hispanic cohort, representing 60 percent of the total U.S. Hispanic population. They are found primarily in the fast-growing sunbelt states of Texas, Arizona, Colorado, New Mexico, and California ("Hispanics in the Nation," 1982; Estrada, 1983). Yet, Mexican Americans are virtually nonexistent in college programs and professions related to mathematics, science, and technology. In 1981, Hispanics comprised less than 3 percent of the bachelors, less than 2 percent of the masters, and less than 1 percent of the PhDs in each of the following field categories: physical science, mathematical science, computer science, engineering, and life science (Malcom, 1983).

Intervention projects to alleviate a lack of highly trained technicians and scientists have recently been established at the secondary and postsecondary levels. These offer a glimmer of hope for the future participation of Mexican American students in mathematics, science, and technology-based fields. However, it is clear that

noticeable breakthroughs in terms of academic achievement, persistence, number of graduates, and persons employed in mathematics- and science-related careers can occur only if concrete school and college initiatives for Mexican Americans, women, and other minorities become institutional priorities. In short, Mexican Americans must have the opportunity to participate successfully in institutional infrastructures designed to train a talented pool of individuals who will determine and lead the country's future in high technology, science, medicine, and engineering.

Purpose of the Guide

The purpose of this guide is fivefold: (1) to review the state of mathematics and science education for Mexican American students, (2) to examine the student- and institution-based factors which contribute to the underrepresentation of Mexican Americans in mathematics- and science-related fields, (3) to spotlight exemplary school and college intervention strategies, (4) to determine the components and key elements of successful model programs, and (5) to propose practical suggestions for ways parents, teachers, counselors, program planners, and administrators can plan, develop, and implement mathematics and science intervention programs.

In keeping with the purpose above, this guide is directed toward teachers, counselors, administrators, and parents at the school and college level. The guide

will provide this audience with practical how-to-do-it suggestions for encouraging Mexican American students to develop an interest and to succeed in science and mathematics programs.

THE STATE OF MATHEMATICS AND SCIENCE EDUCATION FOR MEXICAN AMERICANS

A contemporary analysis of the state of mathematics and science education for Mexican Americans is limited by three major factors. First, statistical definitions of Mexican Americans tend to vary. Depending on the researcher, Mexican Americans may be identified as Chicano, Latino, Mexicano, Mexican, or other diverse ethnic labels. Second, some researchers prefer to aggregate Mexican Americans, Puerto Ricans, Cubans, and other diverse Latin American group nationalities under the umbrella term, "Hispanic." Third, most available data specific to Mexican Americans, or "Hispanics," in mathematics and science fields is incomplete, outdated, or poorly presented. In spite of these inconsistencies, it is possible to examine existing data and extract indicators which provide a sketchy, but useful, portrait of Mexican American participation and success in mathematics- and science-based fields.

A review of the literature provides general indications that access to and progress in mathematics- and science-related fields for Mexican American students appear to be influenced in varying degrees by student- and institution-related factors. The combined impact of these factors at the precollege level as well as during college may account for disparities in educational

achievement between Mexican Americans, whites, and other ethnic groups.

Student-Related Factors Affecting Mathematics and Science Participation and Achievement

The extent of Mexican American participation and successful achievement is linked to student-related factors which fall into three main categories: (1) socio-economic status, (2) academic deficiencies, and (3) attitudes towards mathematics and science.

Socioeconomic Status

A large number of Mexican American students come from low socioeconomic status families with limited financial resources and low levels of educational attainment. The 1980 census indicated that one of five Hispanic households is headed by a female with no male spouse present, and these households were most likely to have children under 18 years of age. The median income for Hispanics was $14,711, compared to $20,840 for whites. About 24 percent of all Hispanics were living below the poverty level in 1979, compared to 10 percent of whites (Estrada, 1983).

The 1980 census also indicated that the educational level for persons of Spanish origin remained among the lowest in the nation. About 56 percent of Hispanics 25 years of age or older had attained less than a high school degree, compared to about 31

percent for whites. Only 7.6 percent of Hispanics 25 years of age or older had earned a college degree, compared to 8.4 percent of blacks and 17.2 percent of whites (Estrada, 1983). The relationship of socioeconomic status to educational attainment is highly significant given the fact that studies have demonstrated that this factor alone accounts for a great deal of Mexican American student attrition in schools and colleges (Commission on the Higher Education of Minorities, 1982; Rendón, 1982).

Academic Deficiencies

Poverty-stricken Mexican American students usually exhibit experiential, psychological, and linguistic deficiencies. Typical of this group are low college entrance examination scores, poor writing and speaking skills, content deficiencies, weak study habits, poor self-images, diffused goals, and unsuccessful learning experiences (Cohen, 1980; de los Santos, 1980; Friedlander, 1979).

Differences between Hispanics and whites in mathematics and science preparation were noted in a study of mathematics and science community college students in Texas, Arizona, and California (Rendón, 1983). While 43 percent of white students enrolled in community college mathematics courses had taken advanced algebra and other higher-level mathematics courses in high school, only 28 percent of the Hispanics had received this type of preparation. Given this substandard

mathematics preparation, it was not surprising to note that Hispanic students tended to be enrolled in mathematics and science developmental courses at higher levels than whites. Overall, white males received a better mathematics preparation and reported fewer problems with mathematics and science courses than did other students (Rendón, 1983).

Similarities between Hispanics and whites in terms of problems experienced in their mathematics and science courses were noted in the same study. Both student groups reported that the major problems experienced in mathematics classes were in the areas of (1) solving word problems, (2) developing study habits, (3) utilizing time effectively, (4) interpreting symbols and formulas, and (5) understanding the teacher's explanations in class. In their science courses both Hispanics and whites indicated that they had trouble reading and understanding the vocabulary used in science books. Like whites, less than 10 percent of the Hispanics reported problems understanding English explanations given in their mathematics and science courses. This finding suggests that knowledge and use of Spanish may not hinder performance in mathematics. Rather, it may be that Mexican American students have not developed sophisticated critical thinking abilities, logical thought processes, or skills in interpreting the written word (Rendón, 1983).

Attitudes Toward Mathematics and Science

Mexican American students may be avoiding career fields requiring extensive mathematics backgrounds because they have developed negative attitudes about mathematics- and science-based fields. For example, many Mexican American women are known to experience a conflict between meeting family obligations and pursuing "masculine" educational aspirations (McCorquodale, 1983). Fields like medicine, engineering, statistics, chemistry, and so forth are known to be heavily oriented toward white males. Hispanic women may be reluctant to enter these fields because they perceive that they cannot compete with men in these professions. One study (Rendón, 1983) found that, although Hispanic and white women reported earning good grades in mathematics, they still perceived more fear, anxiety, and inadequacy in this field than did males of either ethnic group.

Rendón (1983) also noted that 60 percent of Hispanic students in community colleges avoided mathematics- and science-based fields because they felt they "were not good in math," compared to 32 percent of white students. Further, up to 78 percent of the Hispanics compared to 27 percent of the whites disliked mathematics or had no interest in this subject. It is interesting to note that Hispanic parents appeared to have a great deal of influence regarding student choices of high school and college academic programs (National Center for Education Statistics, 1980; Rendón, 1983). Unfortunately, most Hispanic parents have

not earned a high school diploma and are limited in the amount of information and encouragement they can give to their children because they often are not aware of the course offerings and requirements in high school and college (Rendón, 1983).

In short, student-related factors such as socioeconomic status, academic deficiencies, and attitudes towards mathematics and science can certainly be said to have an impact on the participation of Mexican Americans in these fields. However, factors related to the institution may have an equally negative effect on the educational progress of Mexican Americans in these important fields.

Institution-Related Factors Affecting Mathematics and Science Participation and Achievement

Mexican American students by themselves are not to blame for low participation and performance in mathematics- and science-based fields. Inadequate and insensitive institutional structures create major barriers that preclude academic achievement. Therefore, Mexican American underrepresentation in these fields is due to the combined impact of student- and institution-related factors and not to inherent deficiencies in the students. The institution-related factors that contribute to the crisis in mathematics and science fall into two categories: (1) curricular deficiencies and (2) personnel-related inadequacies.

Curricular Deficiencies

It is widely recognized that the quantity and quality of mathematics and science curricular materials and teaching facilities available in most of the nation's schools and colleges are less than adequate. Curricular materials that demonstrate the importance of mathematics and science in everyday life, that stimulate student interest and involvement, and that cultivate problem solving and critical thinking skills are outdated, poor in quality, or too few in number. Further, the nation's classrooms suffer from inadequate facilities and lack laboratories and instruments needed to provide state-of-the-art teaching in mathematics, science, and technology (Malcom, 1983; Today's Problems, 1982).

Personnel-Related Inadequacies

Teacher shortages in mathematics and science have reached a crisis level. In 1980-1981, shortages of physics teachers were reported in 43 out of 50 states; mathematics and chemistry teacher shortages were documented in 35 states (Vetter, 1983). Declines in the number of secondary-level mathematics and science teachers in training are exacerbated by the exodus of experienced teachers lured away by businesses and industries that offer higher salaries and better working conditions. Further, the quality of teachers in training has declined. Many education majors scored low on college entrance exams and National Teacher Examinations. They also had lower grade point averages and had taken fewer

high school mathematics and science courses and other academic subjects than had other college aspirants (Vetter, 1983).

The lack of Mexican American faculty and staff in the nation's colleges and universities is a crucial concern. Rendon (1982) found that one of the key factors contributing to educational goal attainment by Chicano community college students was encouragement given by Chicano faculty, counselors, and administrators. Similarly, other studies have indicated that contact with faculty is a critical element contributing to student persistence (Pascarella & Terenzini, 1979; Beal, 1979; Ramist, 1981). However, Hispanic faculty comprise less than 2 percent of the entire faculty in higher education (Equal Employment Opportunity Commission, 1979). Therefore, colleges and universities lack not only Hispanic leadership critical to policy making but also role models who can give Hispanic students support and encouragement in achieving their educational goals.

Non-Hispanic teachers and counselors who are unfamiliar with Mexican American culture, customs, and background are limited in the amount of support and training they can offer to Hispanic students. Faculty members and counselors often do not recognize that fear and avoidance of mathematics are predominant attitudes with many minority students and that Mexican American women, especially, need specialized counseling to help them overcome feelings of inadequacy about going into male-dominated

professions (MacCorquodale, 1983). Encouragement and support are especially important in the elementary and junior high school grades, when students begin to think about their future careers. Moreover, many teachers and counselors have not received adequate training to teach and work with students with basic skills deficiencies in reading, writing, and mathematical computation (Friedlander, 1979). Since these basic skills are essential for success in mathematics- and science-based careers, students who do not develop these skills are left out of lucrative careers in these fields.

Finally it should be noted that administrative leadership, planning, and support for developing mathematics and science initiatives in schools and colleges often falters. Some administrators lack the knowledge and expertise needed to determine the availability, accessibility, and creative use of resources to support mathematics and science programs. This lack of leadership is unfortunate because the future of Mexican American participation and success in these fields may well depend on decisions made by administrators regarding the number and quality of intervention programs to be developed in the nation's schools and colleges.

The information presented above suggests that intervention strategies must be developed to address the student- and institution-related factors which presently preclude Mexican American student advancement in these fields. The net effect of

these factors has been observed in documented student achievement outcomes which give credence to the notion that the present state of mathematics and science education for Mexican Americans falls far short of what can be considered adequate.

Mexican American Student Outcomes in Mathematics- and Science-Based Fields

The consequences of student- and institution-related factors upon access and achievement are seen in data which reflect disparities in educational achievement between Hispanics and other ethnic groups, and document the severe underrepresentation of Hispanics in mathematics- and science-based fields.

Disparities in Educational Achievement

Academic achievement differences in mathematics and science have surfaced in numerous national, state, and regional reports. While the lack of mathematics and science achievement is not limited to Mexican Americans, on the whole their achievement tends to be lower than that of whites. The National Commission on Excellence in Education (1983) brought the underachievement of the nation's students in mathematics and science to national attention when it reported a steady decline in the science achievement scores of 17-year-olds, as measured by national science assessments in 1969, 1973, and 1977. The

Commission further indicated that from 1963 to 1980 the College Board's Scholastic Aptitude Test (SAT) verbal scores fell more than 50 points and that the average mathematics scores dropped nearly 40 points. Furthermore, scores of the American College Testing Program (ACT) indicated that from 1970 to 1976 the mean mathematics scores dropped from 20 to 17.2, while scores in science remained at 20.8 (Boyer, 1983).

When achievement data are separated according to ethnic groups, it is possible to note differences among the groups. For example, Today's Problems (1982) documented that approximately 15 percentage points separated 17-year-old Hispanics from 17-year-old whites on national mathematics assessment tests in both 1973 and 1978. On tests administered to 9-year-olds in the same years, the mathematics scores of Hispanic students remained constant while those of blacks showed a definite improvement and those of whites declined. The testing program conducted by the National Assessment of Educational Progress (1983) indicated that "consistent with earlier assessments, black and Hispanic students performed below the national level, while their white counterparts performed above the national level" (p. 33). Even though these standardized tests may be culturally biased and not wholly representative of minority student aptitudes, the fact remains that Mexican Americans do demonstrate deficiencies in their precollege mathematics and science

preparation and that these deficiencies are recognized upon college enrollment.

Community colleges, which enroll about 53 percent of all Hispanic students at all levels of higher education in the nation (Kaufman, Dolman, Geoffrey, & Bowser, 1983), and senior institutions face the challenge of responding to poor precollege mathematics and science preparation. In most cases, these institutions have had to increase course offerings in remedial mathematics. However, these course offerings in themselves have constricted the number of Mexican American students entering mathematics- and science-based fields. Poorly prepared, college-bound Mexican American students are disappointed to find that in order to enter a mathematics- or science-related field, they must take several semesters of remedial-level mathematics before they can take college-level courses. Because entry and persistence in mathematics and science education is a winnowing process, when the initial pool of students is small, the actual number who persist to complete the educational process will be even smaller (MacCorquodale, 1983). Thus, unless the actual numbers of Mexican American students in college-level courses increase, participation and graduation rates of this group in mathematics-and science-based fields will remain abysmally low.

Mexican American Underrepresentation

The magnitude of the problem of poor mathematics and science preparation and achievement is revealed in student outcomes reflecting the underrepresentation of Hispanics (see Table 1). While Hispanics comprise approximately 6.4 percent of the U.S. population, their representation in physical science, computer specialties, mathematical sciences, and engineering is so low that it lags behind that of blacks, a group whose own participation level in these fields is dismal (Malcom, 1983; McNeh, 1983).

The situation is no better for Mexican American women, who tend to experience barriers of racism and sexism in mathematics- and science-based programs. Although disaggregated data on minority women is scarce, available figures indicate that of all the science doctorates (including those in the social sciences) awarded in the early 1970s, only 35 went to Mexican American women, while 8,643 went to white women and 814 to black women (Women and Minority, 1977; MacCorquodale, 1983). According to the final report of the Commission on the Higher Education of Minorities (1982), to achieve proportionate representation in engineering, biological science, physical science, and mathematics at the doctoral level, the number of minority graduates would have to increase from four- to sevenfold. Thus, the numbers and quality of intervention strategies developed today will have a far-reaching influence on the future of minority

TABLE 1

Degrees Earned by Blacks and Hispanics in 1981 by Major Fields
(Expressed in percentage of total degrees awarded).

	Blacks*			Hispanics**		
	BA	MA	PhD	BA	MA	PhD
Physical Science	3.78	2.05	1.02	1.69	1.05	0.70
Mathematical Sciences	5.27	2.61	1.24	1.67	1.56	0.82
Computer Specialists	5.20	1.69	0.40	2.00	1.45	0.00
Engineering	3.27	1.59	0.94	1.91	1.70	0.90
Life Sciences	4.07	2.44	1.65	2.14	1.32	1.13
Psychology	8.10	5.30	3.93	3.20	2.24	2.20
Social Sciences	8.08	5.16	3.21	2.87	2.35	1.67

*Blacks comprise approximately 12% of the U.S. population.
**Hispanics comprise approximately 6.4% of the U.S. population.

NOTE: Adapted from An Assessment of Programs That Facilitate Increased Access and Achievement of Females and Minorities in K-12 Mathematics and Science Education (pp. 1-2) by Shirley M. Malcom, 1983. Washington, DC: Office of Opportunities in Science.

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representation in mathematics- and science-based fields.

In summary, the state of mathematics and science education for Mexican Americans is marked by student- and institution-related factors which combine to restrict access, to limit achievement, and ultimately to constrict future career opportunities in scientific and technological professions. To address the underrepresentation of Mexican Americans in these fields, schools and colleges must develop intervention strategies which provide students with academic and student support services that enhance persistence in achieving educational goals. The next section reviews some of the most exemplary school and college level mathematics and science initiatives which have been successfully implemented with Mexican Americans as a main target group.

SCHOOL AND COLLEGE MATHEMATICS AND SCIENCE PROGRAM MODELS

The thrust toward improving mathematics and science education in the United States has spawned numerous intervention strategies in schools and colleges. Those which address Mexican Americans may be found primarily in educational institutions in the Southwest, where this ethnic group predominates. However, it should be noted that most model programs described in this section are geared for all ethnic minorities which comprise the population surrounding the institutions. Therefore, while most models do not focus solely on Mexican Americans, this group represents the largest minority population and thus is designated as a main target group.

Since a thorough description of all mathematics and science models at southwestern schools and colleges is beyond the scope of this study, this section will spotlight selected models to give readers a glimpse of what is presently being done to address Mexican American student underrepresentation in these fields. An extensive list of model programs and activities is provided as Appendix A. A list of resource organizations with expertise in various aspects of setting up models is presented as Appendix B. Information about the models in this study was secured by having program

directors complete the "Math/Science Program Survey" included as Appendix C.

Models that Target Precollege Students

It is widely recognized that early intervention at the precollege level can foster interest, motivation, and participation in mathematics and science programs. Some of the most innovative and successful models involve collaborative partnerships between schools and colleges. These programs allow for early identification of students who plan to major in mathematics and science so that they may be motivated and prepared to enter and be successful in college-level programs.

MESA Program

One of the most replicated programs in the nation is the Mathematics, Engineering, Science Achievement (MESA) program. Initiated in 1970, MESA has been designed to work with high school minority students who are interested in careers requiring a year of college mathematics. The program requires that students study college preparatory mathematics, science, and English each year. It offers tutoring, counseling, career development, and incentive awards that encourage academic achievement. MESA centers are located at universities with strong engineering and physical science departments. At least 15 of these centers are located in California

universities, although the popularity of the program has spread to other states.

Minority students are eligible to apply for a MESA summer program as early as the tenth grade. To remain in the program, MESA students are required to enroll in college-preparatory mathematics, English, and science; to maintain an overall above-average grade point average; and to participate in activities such as student meetings, study and tutoring sessions, field trips, and a MESA-approved summer enrichment program. An important feature of this project is parental involvement. Parents may participate in activities by approving participation in MESA program activities, attending orientation sessions, reinforcing the program's academic requirements, participating in field trips, hosting student groups, attending informational workshops, assisting with transporting of students to evening study sessions, and participating in a MESA Parent Advisory Organization. The program receives funding from private foundations, industry, and universities that sponsor MESA centers. MESA has developed an evaluation system which enables fund providers to know exactly what they are getting for their investment. For example, evaluative information of 1983 MESA graduates indicates that the largest number of program graduates were among Mexican American students--from 354 in 1982 to 422 in 1983. Since 1979, about 94 percent of MESA students have pursued university studies and nearly 66 percent have chosen mathematics-based fields of study.

High-Technology High School at San Antonio College

Initiated in the fall of 1983, the High-Technology High School (HTHS) represents an innovative effort to attract talented high school students in the 16 independent school districts in Bexar County who desire intense education in mathematics, computer science, and the natural sciences to get their training at a community college. The result of a community-wide effort to increase educational opportunities for high school students in San Antonio, the program enrolls more than 70 juniors and seniors, most of whom are Hispanic. With the aid of parents, faculty, and counselors, students ending their sophomore year determine whether to take courses leading to undergraduate degrees or to enroll in courses leading to a high-technology career upon high school graduation. Students seeking undergraduate degrees enroll in Phase I of the school. This phase concentrates on building a solid base of knowledge in mathematics, computer science, logic, technical and scientific writing, chemistry, biology, and physics. Phase I prepares students to be eligible to apply and be accepted at the best colleges and universities in the country. Phase II of the project is for students who wish to begin careers in business, industry, science, and technology (related to computers and electronic fields). Upon successful completion of required courses, these students are eligible for employment immediately after high school.

Students in the HTHS attend their home high schools in the mornings and the HTHS at San Antonio College in the afternoons, between 12:15 and 4:30. Students are expected to graduate from their home high schools; and in addition to their high school diplomas, they receive a special certificate citing the successful work accomplished at the HTHS. The program receives funding from the Texas Education Agency, the college district, and the local independent school districts.

San Antonio Independent School District Biomedical Program

A school/college partnership model which identifies students as early as the junior high school level is seen in the San Antonio Independent School District (SAISD) Biomedical Program. A cooperative effort with the University of Texas Health Science Center, this program is designed to upgrade and reinforce the student's scientific knowledge while developing computation, reading, and writing skills. These skills are introduced through enriched studies in biology, chemistry, mathematics, and scientific literature and through science projects.

In this 5-year program, students scoring at or near the 90th percentile on an average of reading and mathematics scores of the sixth or seventh grade Metropolitan Achievement Test are screened as possible candidates. Participants begin the Biomedical Program in grade eight and

continue through grade twelve. In addition to regular classes in junior high school and high school, students attend 3-hour biomedical classes twice a week at the University of Texas Health Science Center. Students thus develop an awareness of medical careers and become prepared for undergraduate pre-med programs through interaction with medical school instructors, counselors, and students.

In the long term, the program seeks to prepare and motivate students to enter graduate programs in medicine, dentistry, nursing, and related health fields. The program receives 100 percent institutional funds and is evaluated by the Texas Education Agency and the SAISD Department of Evaluation.

TAME Program

The Texas Alliance for Minorities in Engineering (TAME) represents an intervention strategy designed to increase the number of minorities in engineering, scientific, and computer professions. TAME works through a system of 14 local alliances comprised of education, industrial, government, and community groups. With corporate-sponsored support, each alliance works independently in its own community to ensure that local resources are maximized and that local needs are met. For example, the alliances sponsor activities targeted at junior high and high school students. These include scholarship programs, co-op programs, poster contests, "Engineering

Days," visits to local industries, engineering symposiums, data processing classes taught by corporate employees, corporate "adoptions" of high schools, mathematics and science faculty luncheons, and summer mathematics and science programs at colleges and universities. One of TAME's most visible projects is EXPO-TEX, a 30-foot van which tours the state every year, spending between 2 weeks and a month in each TAME alliance area. The van contains rotating exhibits donated by engineering-oriented firms.

TAME has had impressive outcomes. From 1981 to 1982, engineering enrollment of Hispanic students in Texas increased by 16 percent. In 1983, when minority freshman engineering enrollment declined nationwide, minority enrollment in Texas's 12 colleges of engineering increased by 20 percent over the previous year. The success of TAME's initiatives is best documented by the fact that Texas's minority engineering enrollment is now at 8.6 percent, compared to 3.5 percent nationwide.

South Texas Engineering, Mathematics, and Science (STEMS) Program

The STEMS program at Texas A&I University in Kingsville works with school districts in South Texas. It identifies its goal as developing and implementing a comprehensive support system to identify, motivate, and prepare an increased number of students to successfully pursue science and mathematics courses in college.

The program, which receives multiple corporate funding, revolves around three major components. The first component is a career awareness and development activity for junior and senior high school students; it informs students about engineering opportunities through literature, tours, and speakers. The second component is a staff development project for target school districts. These school districts are assisted in four major activities: (1) organization of science, mathematics, and engineering clubs and science fairs; (2) organization of staff development workshops; (3) establishment of a Mathematics, Engineering, and Science Education Clearinghouse at Texas A&I which makes curriculum materials available to school districts; and (4) development of alternative strategies to effectively seek, obtain, and utilize federal and state funds to support mathematics and science programs. The third component is a summer enrichment program for 9th, 10th, and 11th grade students who wish to pursue an engineering career. Ninth graders attend a 1-week program featuring academic and career planning, motivational films and speakers, hands-on experiments, and at least one field trip. Tenth and eleventh graders attend a 2-week program involving academic and career counseling, supplemental math and science challenge exercises, experiments, speakers, and/or field trips. The program also features a student-selection and computerized-tracking system to provide year-round counseling and support as students progress through high school.

Minority Enrichment Seminar in Engineering Training Program

The Minority Enrichment Seminar in Engineering Training Program at the University of Houston provides intensive 2- to 3-week summer activities for minority students. Exceptional high school students are identified and brought to the university to participate in mathematics and science courses, to attend lectures and field trips, to view films, and to visit local industrial sites. Other activities include academic skills assessments, career awareness, and social functions. With a special emphasis on engineering, this program includes extensive faculty and counselor contact and visits with upper-level engineering students and local Hispanic industrial engineers. The program receives corporate funding.

Transitional Engineering Summer School Program

The University of Houston Transitional Engineering Summer School Program allows minority high school students who intend to enroll in an engineering school in the fall to satisfy some, if not all, prerequisites. As a "bridge" program, it allows students who are not eligible to attend the university's engineering program to take preparation courses in introduction to engineering, problem solving, reading, and study skills, as well as in mathematics and English. Retention strategies include diagnostic testing, academic advising, progress monitoring, tutoring, and personal counseling.

Southwest Resource Center for Science and Engineering

The Southwest Resource Center for Science and Engineering is sponsored by the University of New Mexico and the Northern New Mexico Consortium for Rural Education. The center serves five member school districts in the consortium through a teacher training program in computer- and mathematics-related topics. Selected elementary, middle, and nigh school teachers receive training in problem solving and discovery learning in mathematics, use of microcomputers in the classroom, mathematics pedagogy and content, probability and statistics, mathematical modeling, implementation of computer courseware, and courseware development in mathematical modeling, among other topics. The project features a newsletter on microcomputer technology and its uses in education. The program is based on the premise that well-trained, enthusiastic teachers are the key to motivating and preparing students to enter mathematics- and science-based fields.

Parental Involvement Program

A program to increase parental involvement in their children's education is exemplified in a collaborative effort between Texas Southmost College and the Brownsville Independent School District as part of the Ford Foundation-funded Math Intervention Project of the Border College Consortium. Under the leadership of a task force comprised of community college and

school district administrators and faculty, a booklet targeted at parents of children in the school district was developed. The bilingual publication, "Padres, Hijos y Las Matemáticas/Parents, Children and Mathematics," features photographs and comments of parents, students, faculty, and community people stressing the importance of mathematics in the future and outlining the variety of mathematics courses available in high school and college.

A second project undertaken by this task force was the creation of videotapes directed at parents and children at the school and college level. One videotape, directed at elementary school children, emphasizes that mathematics is easy and fun; another videotape, geared for secondary school and college students, stresses the importance of taking mathematics courses for use in academics and everyday life.

Women in Science and Engineering Office

The paucity of minority women in mathematics and science fields is addressed by the Women in Science and Engineering Office at the University of Arizona. Efforts of this office include newsletters, a network of local women in science and engineering who are available for informal counseling, and scholarships and social activities for women of all ages. The primary yearly activity is a Science Career Workshop, which allows junior and senior high school women to consider specific

mathematics and science fields as career alternatives.

Promotion and Awareness of Careers in Engineering Program

The Promotion and Awareness of Careers in Engineering (PACE) program is sponsored by the Mexican American Engineering Society in Washington, D.C. Funded by the National Aeronautics and Space Administration, the PACE program seeks to promote science and technical careers to junior high, high school, and college students by using peer involvement through college student chapters. These chapters work directly with junior high and high school students to advise them of requirements and expectations of college life. The chapters also conduct study and organizational sessions on topics of interest in engineering.

Models That Target Community College Students

Border College Consortium Math Intervention Project

At the two-year college level, a multiple-site, comprehensive mathematics model is represented by the Math Intervention Project sponsored by the Border College Consortium and funded by the Ford Foundation. The Border College Consortium is comprised of six community colleges located along the United States/Mexico border in Texas, Arizona, and California.

The colleges include Texas Southmost College and Laredo Junior College in Texas, Cochise College and Arizona Western College in Arizona, and Imperial Valley College and Southwestern College in California.

The Math Intervention Project's consortium organizational framework allows for close institutional collaboration among college administrators, faculty, and counselors. Through institutional resource sharing and cross-pollinization of concepts and activities, the six consortium colleges are able to adapt, integrate, and institutionalize particularly successful mathematics activities from one institution to another. Mathematics-related activities undertaken by the consortium institutions include (1) conducting research studies, (2) developing a mathematics tutorial program, including a tutor training packet, (3) creating a mathematics anxiety course, (4) developing an articulation model designed to analyze high school mathematics courses for content and objectives in order to evaluate student preparation, (5) creating videotapes of mathematics lessons for tutorial use, (6) examining mathematics placement tests to improve their reliability and validity, (7) creating self-paced courses in beginning and intermediate algebra, and (8) conducting resource sharing and staff development activities with technological institutions in Mexico.

Models That Target Four-Year College Students

Minority Biomedical Research Support Program/Biomedical Research Program for Ethnic Minority Students, and Honors Undergraduate Research Training Fellowship Program

At the college level, some programs emphasize biomedical fields. These include the Minority Biomedical Research Support Program at the University of New Mexico School of Medicine, Albuquerque; and the Biomedical Research Program for Ethnic Minority Students and the Honors Undergraduate Research Training Fellowships at New Mexico State University, Las Cruces. These three programs are geared toward increasing the number of high-ability minority students in biomedical research careers. A distinguishing feature of these programs is close student-faculty contact. Students are given the opportunity to gain experience in an apprenticeship situation with chemistry faculty and successful researchers in biomedical fields. Students are encouraged to conduct independent research and to become involved in activities such as writing manuscripts for lay magazines and peer-reviewed journals, developing grant proposals, and presenting papers at scientific meetings.

The biomedical research program at New Mexico State University boasts that 66 percent of all students who experienced the program as undergraduates successfully gained entrance into postgraduate schools in

such fields as medicine, dentistry, and veterinary medicine. About half of the graduates earn graduate degrees, and the other half earn medical degrees. These programs are funded primarily through grants from the National Institutes of Health.

Minority Engineering Program and Engineering and Computer Science Educational Laboratory

Two programs aimed at increasing the number of minority graduates in engineering are the University of California, Los Angeles, Minority Engineering Program and the Engineering and Computer Science Educational Laboratory at the University of California, Irvine. Both programs provide intensive academic and support services designed to improve performance and retention levels of minority students. These activities include the use of student study groups, tutoring, and study skill development; instructional sessions in chemistry, mathematics, reasoning, and problem solving; and academic advisement and career development.

Professional Development Program

One of the most successful and widely disseminated intervention models is the Professional Development Program (PDP) at the University of California, Berkeley. The PDP sponsors a summer program for high-achieving minority high school juniors and seniors. The program offers students enrichment courses in mathematics, English,

and science as well as college and career advisement. Further, the PDP sponsors undergraduate and graduate programs where minority students receive instruction in mathematics, chemistry, and physics and also obtain academic and career counseling. The PDP is based on the premise that many minority science and engineering students lack strong academic skills, a supportive academic peer group, and a knowledge of how to use campus support services effectively. Thus, the PDP features a Math/Science Workshop where students are immersed in highly structured, intensive group activities focusing on developing study groups, determining methods to "learn the ropes" of the institutional system, and fostering group interactions.

The Math/Science Workshop is nonremedial in nature, and students are placed in courses for which they have adequate prerequisites, thus creating an atmosphere of academic excellence. Students needing remediation arrange for individual study sessions. Other significant PDP activities include orienting students to the university, monitoring student academic progress and adjustment to the university environment, providing supplementary instruction in reading technical language and using mathematical language and form, and assessing the understanding of mathematical concepts and terms. PDP workshop minority students have consistently outperformed nonworkshop minority counterparts in target courses; further, the average grade of workshop students in many

target courses has been equal to or greater than that of their nonminority classmates.

The selective models which have been described here provide evidence that programs which target Mexican American and other minority groups at the school and college level have achieved success. They are available for replication in other educational settings. The next section addresses the organizational components which comprise successful mathematics and science model programs; these components may be adopted or adapted in schools and colleges wishing to develop their own mathematics and/or science intervention programs.

ORGANIZATIONAL COMPONENTS OF MATHEMATICS AND SCIENCE PROGRAM MODELS

After a decade of experience with mathematics and science initiatives for minority students at the school and college level, it is certain that viable, replicable intervention models do exist, and future models need only build upon the successful organizational components of these programs. Institutions preparing to develop and implement a mathematics or science program need to determine the organizational components which will structure and provide the overall organizational framework for their model. For each model, the following determinations must be made:

1. Does the model reflect the college or school mission? In other words, may the program be considered an outgrowth of the institution's overriding philosophy?

2. Is the program central to the policies and objectives of the mathematics and science department(s)?

3. What will be the organizational design of the project?

4. What type and level of students will the model target?

5. What will be the model's curricular focus?

6. How will the program be funded?

7. How will the program be evaluated?

8. What kinds of outcomes are expected from the project?

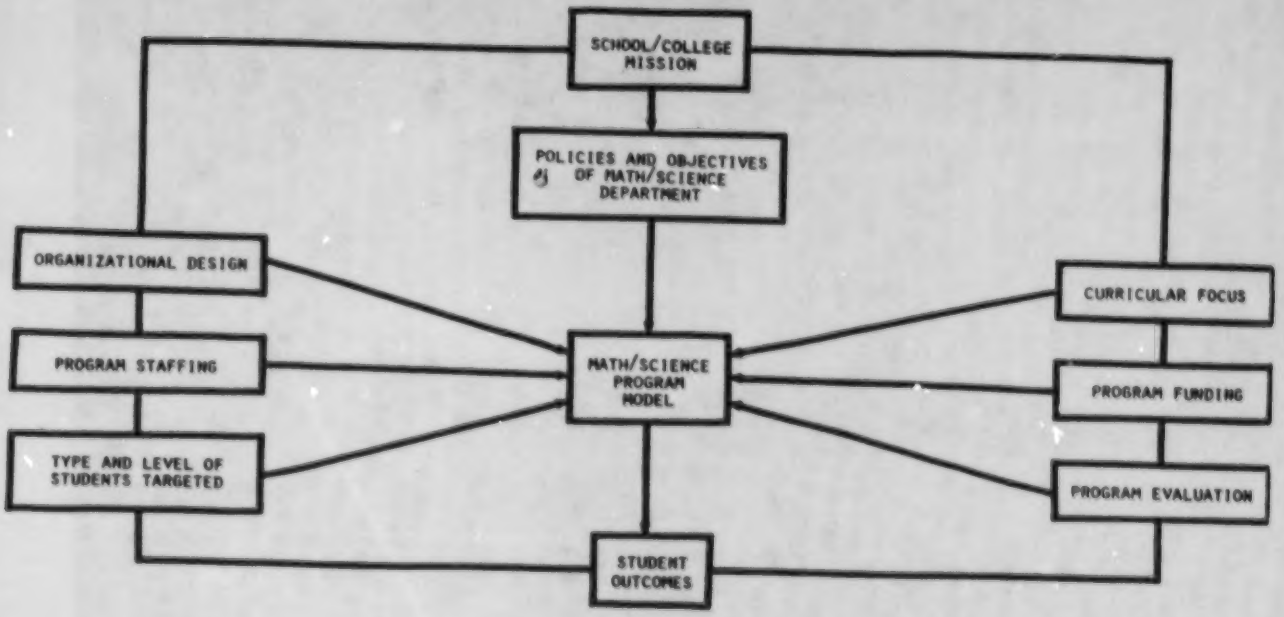
Figure 1 depicts the organizational components of a mathematics/science program model. Several issues must be addressed for each component.

The School or College Mission

The guiding philosophy of the institution should dictate the appropriateness of mathematics/science intervention models. Most institutional missions support the principle that all citizens, regardless of sex, ability, or ethnicity, are entitled to be educated to the extent of their abilities. This notion creates an institutional responsibility to address the intellectual, emotional, physical, and social needs of the individuals they serve. Thus, mathematics and science education models can be outgrowths of a specified institutional mission.

Figure 1

Organizational Components of a Mathematics/Science Program Model.



Policies and Objectives of Mathematics/Science Departments

The mathematics/science model must not only reflect the institutional mission but must also grow out of the policies and objectives which guide the department. Thus, it is important to determine how the proposed model relates to the priorities of the department and to decide whether or not the model is viewed as a long-range departmental commitment.

Organizational Design

Mathematics/science intervention strategies usually take on one or more of the following organizational designs:

1. Partnership Between School District, Four-Year Institution, and Industry. These are highly effective designs where diverse financial resources are pooled to create maximum outcomes. Students may be identified as early as the elementary-school level and brought to the university for enrichment or college-level courses. Models using this organizational design include MESA, located mostly in California, and TAME, in Texas.

2. Consortium of Colleges and Schools. Some colleges with similar student populations have organized themselves to work on mathematics and science initiatives. Advantages of this design include the sharing of workable

concepts and collaborating on issues of mutual interest which allow consortium institutions to adopt, integrate, and institutionalize particularly successful mathematics activities from one institution to another. A model using this design is represented by the Border College Consortium, a group of six community colleges located along the United States/Mexico border in California, Arizona, and Texas.

3. Partnership Between Institution and Hispanic Organization. An example of this design is the Promotion and Awareness of Careers in Engineering (PACE) program. In this model, an Hispanic organization takes the leadership to create student university chapters which in turn work with youth from secondary schools to expose them to technical and scientific careers and to advise them of the requirements and expectations of college life.

4. Institutional Cluster Program. Some institutions provide academic and student support services to a cluster of mathematics and science students. A sense of community which fosters camaraderie among students, faculty, and staff is created to allow for encouragement and support. This type of design is used by the Engineering and Computer Sciences Educational Laboratory at UC-Irvine and the Minority Engineering Program at UCLA, as well as the Professional Development Program, UC-Berkeley.

5. Student/Faculty Mentorship. To increase achievement and retention among four-year college and graduate students, some colleges arrange for students to work with an experienced faculty member who serves as a mentor. Examples of this design include the Biomedical Research Program for Ethnic Minority Students and the Honors Undergraduate Research Training Fellowship Program at New Mexico State University.

Program Staffing

Faculty, counselors, and administrators who work with mathematics/science models are the keys to success of the program. In attracting the best professional staff to work with the model, the following issues need to be addressed: (1) How and from where will the professional staff be recruited? (2) What kinds of incentives will be available to the professional staff who work with the model? (3) What will be the functions of faculty, counselors, and administrators? (4) What kind of training will be available for non-Mexican American professional staff?

Type and Level of Students Targeted

The programs' admission requirements dictate the type and level of students who will be targeted in the model. Determinations should be made about whether the program will work with (1) only high-ability

students, (2) students with less ability who show potential, (3) remedial students, or (4) a combination of these types of students. An operational definition of students eligible to participate in the model should be part of the admissions criteria. "Students who have completed two years of high school algebra and one year of chemistry and geometry and who graduated in the top one-third of their class" is an example of an operationally-defined admissions requirement statement. Further, the model may be directed to students at one or more different educational levels: elementary, junior high, high school, two-year, four-year, or graduate.

Curricular Focus

At the core of a mathematics/science intervention strategy is the emphasis given to the curriculum and the kinds of learning experiences offered for the students it serves. The key issues which need to be addressed about a model's curricular focus include the following:

(1) What specialized area of mathematics/ science will be addressed in the model (engineering, biomedical, statistics, allied health, etc.)? Or will the model include a broad range of preparation in mathematics and science?

(2) What is the nature of the program (i.e., developmental/remedial, honors, or some combination of both)?

(3) What kinds of academic activities will be offered? Possibilities include teaching communication skills such as writing research papers, analyzing research, and making oral presentations. Also, students may be exposed to the use of computers or perhaps taught scientific concepts related to the Mexican American culture, such as the use of herbs for medicinal purposes and the functions of the Aztec calendar as it relates to astronomy, to cite some examples.

(4) What kinds of student support services which create conditions conducive to learning will be available for students? Examples of these services include tutorial assistance; the creation of network peer support groups; academic, personal, and career counseling; special counseling for Mexican American women who experience familial conflicts and insecurities about going into male-dominated professions; and the use of parents for counseling, tutoring, and reinforcement to enhance student morale, motivation, and achievement.

Program Funding

Given current financial constraints facing most schools and colleges, securing funding for mathematics/science models is very important. Mathematics and science models may be funded by one or more of the

following sources: the federal government, private foundations, states, corporations and industries, institutions, or private donations. Federal funding sources include, but are not limited to, the National Science Foundation, the Minority Institutions Science Improvement Program, the National Action Council for Minorities in Engineering, Title III of the Higher Education Act of 1965, the National Institutes of Health, the Fund for the Improvement of Postsecondary Education, and the National Aeronautics and Space Administration.

Private foundations which have funded mathematics and science initiatives include the Ford Foundation, The Carnegie Corporation, the Atlantic Richfield Foundation, the Amoco Foundation, and the Shell Company Foundation, among others. In some cases, states have set up special funds for mathematics and science initiatives; among these is the California Governor's Program for Investment in People. Corporate and industrial funding sources are numerous. Among those corporations which have funded mathematics and science intervention projects are Monsanto, Bendix, Exxon, Dow, Celanese, Marathon Oil, Amenoil, Atlantic Richfield, IBM, Hewlett-Packard, Mobil Oil, Tenneco, Texaco, and Union Carbide. Of course, most schools and colleges provide direct and indirect funds to support mathematics/science initiatives. However, the list of external funding sources is extensive enough that schools and colleges with limited resources need not deplete their own funds to develop creative

mathematics and science models for minority students.

Program Evaluation

A critical component of mathematics/science models is program evaluation. One of the best guides for evaluating mathematics and science models is Evaluation Counts: A Guide to Evaluating Math and Science Programs for Women (Davis & Humphreys, 1983). Although the guide focuses on women's mathematics and science programs, the information is applicable on a wider basis. Davis and Humphreys (1983) indicate that program evaluation is important because it gives knowledge, helps to plan, shapes policy, documents achievement, attracts funds, indentifies successful innovations and the best interventions so that they may be replicated and adopted, and educates the public about the continuing need for model programs. Because the evaluation process is so important, determinations need to be made regarding who will be involved in it, who will conduct internal and external evaluations, and what type of evaluative data will be collected.

Student Outcomes

A good mathematics/science model should document student outcomes. Careful documentation and evaluation of program activities can be of value in determining student outcomes. Determinations need to be

made regarding how data should be derived for the following variables: (1) number of students who entered the program, (2) number of students who completed the program, (3) reasons for withdrawal, (4) average student grade point averages, (5) average student scores on pre- and postassessment instruments, (6) number of students who went on to other colleges and universities, (7) success of students once they left the program (i.e., grade point averages, persistence rates, employment), (8) student selection of major fields of study, and (9) comparison of Mexican American student achievement with other ethnic groups.

In summary, the creation of mathematics and science intervention models for Mexican American students requires that specific determinations regarding the model's organizational components be made. Once these are identified and defined, it is possible to enhance the model with key elements which have contributed to the success of other programs. The key elements of educationally powerful mathematics and science models utilizing the components described in this section are presented in the next section.

KEY ELEMENTS IN SUCCESSFUL MATHEMATICS AND SCIENCE PROGRAM MODELS

The success of mathematics and science models in schools and colleges is fostered by key elements related to each of the components which comprise the overall program. In essence, these elements represent the internal mechanisms of educationally powerful models and therefore comprise the bases for creating an internal structure conducive to student motivation and achievement, faculty and counselor enthusiasm and commitment, parental involvement, and program continuation and eventual institutionalization.

School/College Mission

Successful mathematics/science intervention models reflect the overriding school or college philosophy. Thus, it is important that institutions examine their role in serving Mexican American students, women, and other minorities and note the importance given to addressing the underrepresentation of these groups in mathematics- and science-based fields. The most successful mathematics/science models are those which reflect these issues as institutional priorities.

Policies and Objectives of the Mathematics and Science Departments

In the most successful intervention strategies, the activities implemented are those which are central to the goals, objectives, and priorities of the mathematics/science department. When models for minority students are articulated in the department's policies and objectives, faculty avoid being peripherally involved and become active, committed constituents in the model. Thus, it is important that the ownership of the project be placed with the entire department to ensure faculty involvement and commitment to the project and to facilitate the institutionalization of the program within the department.

Organizational Design

The most effective models appear to be those which link a school with a college or university in a collaborative effort to increase the pool of minorities in mathematics- and science-based fields. Programs such as MESA in California, TAME in Texas, and PRIME in Philadelphia represent some of the most successful and replicated programs in the nation. A distinguishing feature of these models is their close working relationship with corporate sponsors. The sponsors not only contribute to project funding but also serve in an advisory capacity to identify community training needs. They may act as consultants, facilitate visits and field trips to industrial sites, and arrange for

internship situations where students can get "hands-on" experience. These models feature early student identification and intervention. Students may take concurrent classes in school and college and may attend summer enrichment programs designed to upgrade mathematics, science, study, and communication skills. The models provide early intervention and long-range, in-depth learning experiences, enabling the students to make early career decisions and channel their interests and coursework into tangible activities provided within the program.

Program Staffing

Faculty, counselors, and administrators are critical elements in mathematics and science program models. In the most successful models, these professionals are recruited with the intent that they will be active participants in structuring project goals and objectives, advising students, contributing to the evaluation process, and ultimately ensuring the overall success of the program (see Figure 2). In successful models, the professional staff views intervention strategies not as low-priority initiatives that "someone else" should handle. Rather, the professional staff views these models as central to department priorities and worthy of active involvement and the time commitment necessary to build and structure the total program.

At their best, faculty, counselors, and administrators serve as role models for nontraditional students entering

Figure 2

Functions of Faculty, Counselors, and Administrators in Mathematics and Science Models.

FACULTY

- Active program participants
- Build and structure total academic program
- Act as role models
- Provide for close interaction with students
- Teach skills and concepts
- Act as faculty advisory/mentors
- Participate in evaluation process

COUNSELORS

- Active program participants
- Build and structure total student support services program
- Act as role models
- Provide for close interaction with students
- Identify and encourage Mexican American males and females
- Communicate with parents of students in program
- Monitor students closely
- Ensure students take proper course sequence
- Ensure students are familiar with specific program requirements
- Provide career awareness
- Participate in the evaluation process

ADMINISTRATORS

- Active program participants, especially with regard to leadership
- Provide leadership to build and structure overall program objectives
- Act as role models
- Elicit and build internal and external enthusiasm and support for program
- Articulate project to institution and community
- Identify potential funding sources
- Participate and provide leadership in the evaluation process
- Create program advisory committees
- Seek ways to provide incentives for program staff

mathematics- and science-related fields. Mexican American students need to be surrounded by professionals who not only serve as role models, but also provide encouragement, inspiration, and expertise to enhance persistence in and the acquisition of mathematics and science skills. Committed, well-qualified faculty, counselors, and administrators who enjoy the challenge of working with Mexican American students can make the difference between their success and failure. When possible, Mexican American role models should be used. Otherwise, training for the non-Hispanic professional staff should include the recognition of socioeconomic, familial, and cultural differences which distinguish Mexican Americans from other student groups. Successful program models include incentives for professional staff in the form of recognition for excellence in teaching, extra compensation, release time, and merit pay, among others.

It is essential that faculty provide opportunities for close, daily interactions with students in and out of the classroom environment. In this manner, students receive constant reinforcement while acquiring the skills needed to succeed in their chosen professions. In view of these general guidelines, therefore, specific functions arise out of active faculty participation in the program. Close interaction with students allows teachers to serve as role models as well as advisors and mentors.

Counselors have the responsibility to identify and encourage potentially successful Mexican American males and females to participate in mathematics- and science-based fields of study. Counseling intervention strategies include academic, personal, and career advisement. It is important that counselors inform students about different mathematics- and science-related fields, including salaries and educational requirements. Students may be taught to write resumes and prepare for job interviews, assisted in transferring from high school to two- and four-year colleges, and advised to take proper course sequences. Further, counselors should work with parents who fear or do not fully understand the system of higher education. In some cases, Mexican American parents who did not attend college or finish high school experience uncertainties about their children going to college. Parents may fear the unknown or be alarmed that their children will lose close ties with family, culture, or values. In these instances, counselors should use care in orienting parents to recognize the benefits that obtaining a higher education can have for their children's future. It is also helpful for counselors to work with parents of Mexican American women who may feel that the family is reluctant to "let go" of them.

Administrators bear the leadership responsibility of inducing active participation on the part of faculty, counselors, students, and parents in the overall program. Moreover, administrators must elicit institution and community

support for the program. Without this support, a program tends to lose credibility and importance. One way to foster this support is to create a program advisory committee comprised of institution and community representatives and parents that act as consultants or advisors providing resources and expertise to the project. Administrators should communicate with institutional and community representatives to inform them of the project's progress and accomplishments. To ensure program continuity, administrators have the task of identifying and making use of all available resources and funding opportunities which may keep the program alive.

Type and Level of Students Targeted

Two important messages appear to emerge from most program directors about the type and level of students a model should target. The first is "get them while they are young." This message translates into recruiting and training students as early as elementary school and no later than the junior high school level, when students begin to make critical career decisions. The second message is "work primarily with high-ability students." Most of the present models recruit and train minority students with above-average academic ability, which is certainly one important factor that can explain the model's success. It remains to be seen how future models can identify, recruit, and train an extensive pool of Mexican American students who have less ability but who show potential. Many of

these potentially successful students have been filtered out of mathematics- and science- related careers because they have underdeveloped academic ability and lack the expertise to weave through institutional systems and to adjust to an academic lifestyle. Although most models do provide some training in these areas, the fact remains that much more needs to be done in terms of identifying, recruiting, and training a broader ability range of Mexican American students.

Curricular Focus

The thrust of curricular activities may be divided into two components: (1) academic and (2) student support services. Academic and support services can complement and reinforce each other to create the most intellectually challenging and positive growth experience for Mexican American students. The most successful models contain key elements from each component (see Figure 3).

Academic Component

In successful mathematics/science models, the academic component is based on measurable entry and exit objectives which are well-identified departmental priorities that are articulated to staff, parents, and students. "The program will recruit, train, and graduate at least 20 Mexican American students in biology and chemistry with career goals in biomedical research" is an example of a measurable program objective.

Figure 3

Key Elements of Academic and Student Support Services Components in Mathematics and Science Models.

ACADEMIC COMPONENT

- Is based on measurable objectives
- Is central to institution and department priorities
- Allows for long-term, multi-year goals
- Includes gifted as well as potentially academically successful students
- Offers continuity and depts of experience
- Allows for incorporation of Mexican American history and experience in math and science
- Provides "hands-on" experiences; apprenticeships
- Teaching focus includes literacy and communication skills
- Exposes students to computers

STUDENT SUPPORT SERVICES COMPONENT

- Builds sense of community among students and professional staff
- Includes parent/student orientation
- Includes parents as tutors and encouragement agents
- Allows for the creation of networks and study groups
- Includes tutoring component
- Allows for personalized counseling, encouragement, and moral support
- Provides for contact with students and professionals already in a math- or science-based field
- Includes remedial/enrichment opportunities

The goals of successful models are usually long-term and multi-year. Even when interventions occur as early as the elementary or junior high school level, the program allows for continuity and increased depth of experience as the student progresses from school to college.

Successful mathematics/science models build high student expectations and include student incentives to encourage them to perform at their best. In some programs, students receive academic excellence awards, are named to a list of honor students, or receive jackets, pens, calculators, and the like in recognition of academic achievement. Many models include "hands-on" learning experiences such as the use of laboratory equipment and exposure to computers or participation in an apprenticeship program with an active and successful scientist or mathematician. While programs strive to develop student mathematics and science skills, it is well recognized that reading, writing, speaking, and listening skills are also critical to solving problems and researching and presenting scientific concepts.

Models addressing Mexican American students may consider teaching ethno-related mathematics and science concepts. The Mexican American culture is rich in historical customs, and its history contains individuals who have contributed to science. However, this heritage has not been fully exploited in mathematics/science models. For example, it is well-known that many Mexican American families use curanderos or

faith healers and view curanderismo, the practice of folk medicine, as an alternative health care system. These practices can be integrated in the teaching of surgery, pharmacy, or chemistry. Further examples include examining nutritional aspects of foods such as tortillas and using the Aztec calendar to introduce concepts in astronomy. The integration of multicultural perspectives ensures relevant content based on Mexican American past, present, and future experience which may enhance student pride and motivation to undertake a mathematics- or science-related career.

Student Support Services

The student support services component complements and strengthens the academic component by creating the social, emotional, and psychological dimensions of camaraderie, moral support, encouragement, and affiliation which are critical to student success. Activities such as personalized counseling, tutorial assistance, orientation, and the creation of student networks and study groups facilitate the building of a sense of community among students and professional staff.

Parental involvement is central to successful mathematics and science models. Parents can be effective in encouraging their children to take mathematics and science courses and to enter career fields requiring these competencies. Further, parents can provide tutoring, guidance, and moral support which can contribute to student retention.

A particularly effective activity which can enhance interest and motivation to pursue mathematics- and science-based careers is to provide opportunities for students to talk to other Mexican American students already enrolled in those fields and to visit with Hispanic professionals in a working environment. Finally, students who need to develop their mathematics and science skills can profit from remedial or enrichment activities which may be offered during the summer or as a special component within a model.

Program Funding

Securing funds from the federal government, private foundations, state programs, or corporations and industries need not be a difficult endeavor. Most agencies look for a general set of criteria to determine a model's funding likelihood. In general, a grant proposal for a mathematics/science model should include the following elements:

- Well-identified and well-documented student, institutional, and community needs.
- Well-defined, measurable objectives related to the purpose of the program.
- A creative, high-quality organizational design which may include the academic and student support services elements used in other verified models.

- A description of the cost-effective use of resources and personnel to achieve the project objectives.

- A well-defined plan of summative and formative evaluation which produces quantifiable data that can be widely disseminated.

- A description of the adequacy of resources (facilities, supplies, and equipment) presently available in the school or college in which the model will be implemented.

- A statement of institutional commitment to the project, including institutional policies that indicate commitment, availability of resources and opportunities, and how institutional administrators and staff will contribute to the policies of the proposed project.

- A description of the qualifications and time commitment expected of key personnel involved in the project.

- An explanation of the cost effectiveness and adequacy of the budget to support the project.

Most mathematics/science intervention program directors feel that long-range funding is better than "one-shot," 1- or 2-week strategies whose outcomes are limited. Further, successful models have incorporated multiple funding sources. Projects using combined funds from

corporations, industries, institutions, and private foundations are common. The eventual institutionalization of a program should always be of concern. When a project can document its cost efficiency and outcomes as well as verify its components and materials so that other institutions may replicate the model, the program tends to gain credibility and support and thus to increase its institutionalization. Therefore, the evaluation component is intricately tied to the initial and continuous funding of mathematics and science intervention models. The key elements of program funding are illustrated in Figure 4.

Program Evaluation

As noted earlier, the evaluation approach should involve the close collaboration of faculty, counselors, and administrators who comprise the model. Joint decision-making tends to establish an open, constructive context for monitoring evaluation activities, data acquisition, analysis, and documentation. Two major types of evaluative data should be acquired and analyzed during the project: (1) intervention and model objectives and (2) impact of model on program participants and on the institution.

Mathematics/Science Intervention Model Objectives

Data should be collected for all prespecified program objectives to determine if outcomes related to each objective have

Figure 4

Key Elements of Program Funding
of Mathematics and Science Models.

- Follow a general set of funding criteria
- Consider long-range funding
- Incorporate multiple funding sources
- Plan for institutionalization
- Document cost-efficiency of the program

been achieved. Critical to this category are data related to (1) student completion rates, (2) grade point averages, (3) majors selected by students, (4) pretest and post-test scores, (5) achievement comparisons of Mexican American students with other ethnic groups, and (6) student follow-ups after they leave the program (i.e., grade point averages and persistence rates at other institutions, type of employment secured, etc.). To properly quantify this important data, it is essential that the program's objectives be written in a measurable format.

Impact of Model on Program Participants and Institution

It is expected that the intervention model may have a number of primary and secondary level effects on program participants and on the institution as a whole. Hence, special instruments or in-depth interviews may be used to obtain data related to (1) parent and student attitudes about the program; (2) faculty, counselor, and administrator perceptions about what worked and what did not work in the program; (3) perceptions of the community about the program; (4) problems students and professional staff experienced while the project was in progress; and (5) sponsor attitudes toward the program. In addition, local instruments may be created to determine the student- and institution-related factors which influenced achievement and persistence.

In general, students and parents as well as professional staff may be involved in formative evaluation, while an external consultant may review the model and prepare a summative evaluation of program accomplishments. Formative evaluation occurs while the program is in progress and functions as a continuous self-correcting mechanism which gives the program staff the flexibility to monitor student progress and to modify teaching, counseling, and tutorial strategies. A summative evaluation involves an end-of-the-year report summarizing the year's activities so that major accomplishments and program milestones may be identified and communicated to the institution, the general public, and program sponsors.

The systematic collection and preparation of information can facilitate the dissemination of exemplary school and college programs which work with Mexican American students to other institutions with similar student populations. It is important that institutions spell out the specific requirements, strategies, and conditions necessary for other schools and colleges to import, adapt, and adopt exemplary mathematics/science intervention models. Thus, models should emphasize careful and comprehensive documentation and user-oriented packaging of all quality-verified project components to facilitate successful implementation of practices and materials from one institution to another. In short, the model should strive to be replicable and portable so that other institutions with similar student

populations will be able to adopt or adapt it. The key elements of program evaluation are illustrated in Figure 5.

Student Outcomes

A well-organized, systematic evaluation will reveal a project's outcomes. Thus, the careful documentation and evaluation of mathematics and science programs cannot be overstated. In the final analysis, an intervention model is only as good as the documented results it achieves.

If models are designed to increase the participation of Mexican American students in mathematics- and science-based fields, then student outcomes should reflect that goal. For example, when a model can document increases in Mexican American student enrollment, graduation, grade point averages, and overall retention, it can be stated that the program had successful outcomes. Moreover, proper documentation of student outcomes makes it possible to identify the most successful mathematics and science interventions that work with Mexican American students. Periodic reports of program progress and an end-of-the-year report which summarizes major accomplishments, project milestones, and overall student outcomes should be made available to project participants, the community, other institutions with similar student populations, and program sponsors.

Figure 5

Key Elements of Program Evaluation

- Documentation of activities and outcomes
- Validation of project components
- Inclusion of formative and summative evaluation
- Participation of faculty, counselors, and administrators
- Collection and analysis of data related to model objectives
- Collection and analysis of data related to model's impact on program participants and institution
- Dissemination of results, key elements of program success, and replicable components

SUMMARY AND RECOMMENDATIONS

The issues presented in this guide have concentrated on four major areas: (1) the problem of Mexican American student underrepresentation in mathematics- and science-based fields, (2) the identification and description of models currently implemented at schools and colleges, (3) the organizational components of mathematics/science models, and (4) key elements which comprise educationally powerful models.

Mexican American students do not participate in mathematics and science school and college programs at levels commensurate with their white counterparts because of student- and institution-related barriers such as poverty, poor high school achievement, lack of encouragement, and poor facilities and materials available in these fields. However, despite these obstacles which restrict access and limit achievement, the current interest and drive to train minorities, women, and non-traditional students in mathematics, science, and technology has promising implications for Mexican American students. First, there is the fact that several school and college initiatives to identify, recruit, and train minorities in mathematics and science have achieved favorable results. Second, most of these programs are replicable and portable. Third, the key elements which make these

models successful have been identified and can be adapted within schools and colleges with similar student populations.

In short, there is promise and hope for the future of Mexican Americans in mathematics- and science-based fields. This hopeful optimism is based in large measure on the extent to which teachers, counselors, administrators, and parents actively work to ensure that mathematics and science programs for Mexican American males and females are implemented and become central priorities in the nation's schools and colleges. To this end, the following recommendations are proposed for each of the key participants in mathematics/science mode s:

Teachers should:

- Encourage Mexican American students to go into mathematics- and science-based fields.
- See students outside of class more often for advisement and reinforcement.
- Develop skills teaching students who have basic skills deficiencies.
- Learn the culture, language, and background of Mexican American students.
- Talk to parents and inform them about their importance in encouraging their children to go into mathematics- and science-related careers.

- Volunteer to work in special mathematics/science models.
- Volunteer to be a teacher mentor for students who wish to learn in an apprenticeship situation.
- Include the teaching of ethno-related mathematics and science concepts in the mathematics/science curriculum.
- Stress that students must develop reading, writing, and speaking skills.
- Focus on having students develop critical thinking, logic, and word problem solving skills.
- Keep up with state-of-the-art developments and innovations in mathematics, science, and technology.

Counselors should:

- Encourage Mexican American males and females to go into mathematics- and science-related courses.
- Arrange to meet with students on a regular basis, not just for registration purposes.
- Inform students about careers in mathematics and science and about course requirements and skills needed to go into these fields.

- Visit and talk to parents of Mexican American students to inform them about how important it is for their children to take mathematics and science courses and to help them develop positive attitudes about their children entering higher education.

- Work closely with faculty in developing materials to help students overcome mathematics and science anxiety.

- Arrange for students to visit and talk with Mexican American students currently pursuing a mathematics/science career and with professionals who work in business and industry.

- Volunteer to work in special mathematics/science models.

- Develop an early identification system whereby students who show interest and potential to succeed in mathematics and science fields can be selected for participation in intervention models.

Administrators should:

- Encourage Mexican American students to go into mathematics- and science-related careers.

- Take the leadership in structuring, securing funds for, and implementing mathematics/science models for students who are underrepresented in these fields.

- Identify, recruit, and hire concerned, committed, and enthusiastic faculty, counselors, and staff who can work effectively with Mexican American students.

- Visit with corporation, business, and industry leaders and solicit their support.

- Take the leadership in developing an evaluation model that identifies student- and institution-related factors that contribute to favorable student outcomes.

- Disseminate information about mathematics/science models and the factors which contribute to successful outcomes to community people and other schools and colleges.

- Take the leadership to ensure commitment, enthusiasm, and support for mathematics/science models within the community and the institution.

- Ensure that state-of-the-art facilities, laboratories, and instruments are available to teachers and students.

- Establish collaborative partnerships involving school districts and two- and four-year colleges in a concerted effort to identify, recruit, and train Mexican American students to enter mathematics- and science-based fields.

Parents should:

- Encourage their children to take more mathematics and science courses and to enter fields requiring these competencies.
- Visit schools and colleges to become familiar with course offerings and requirements for entering mathematics and science fields.
- Volunteer to work in mathematics and science programs as a tutor, counselor, teacher aide, parent organization participant, field trip organizer, and so forth.
- Take an active interest in the educational progress of their children; talk to faculty and counselors about how their child is doing in classes.
- Host student groups in their home where their children and their peers can study together and learn from each other.
- Talk with school and college administrators about the importance of setting up mathematics/science intervention programs.
- Become familiar with the system of higher education and the value that it can have for their children in the future.

- Ask administrators to show them copies of program evaluations and ask questions about data presented in these reports.

Teachers, counselors, administrators, and parents can definitely make a difference in changing the dire state of mathematics and science education for Mexican American students. Mexican Americans can, should, and must take an active role in determining the country's future advances in mathematics, science, technology, engineering, and medicine. Indeed, concrete school and college initiatives can provide the critical opportunity for Mexican Americans to be part of a new generation of scientific and technological experts. No other educational priority carries such potential for dynamic change, innovative developments, intensified economic growth, and social transformation in American society.

APPENDIX A

MATHEMATICS/SCIENCE MODELS AND RESOURCES

Assessment of the Validity of the Cochise College Math Placement Test for the Hispanic Student

Contact: David M. Pettes/George Huncovsky
Cochise College
Rt. 1, Box 100
Douglas, AZ 85607
(602) 364-7943

Biomedical Research for Ethnic Minority Students

Contact: Glenn D. Kuehn
Department of Chemistry
New Mexico State University
Box 3C
Las Cruces, NM 88003
(505) 646-1015/646-2505

Engineering and Computer Science Educational Laboratory

Contact: Jennifer F. Taylor
University of California, Irvine
204 Engineering
Irvine, CA 92717
(714) 856-6234

or

Sharon Gomez
Special Services
Trailer Court 901
University of California, Irvine
Irvine, CA 92717
(714) 856-6450

High Technology High School

Contact: Raul S. Murgia
San Antonio College
1300 San Pedro Avenue
P.O. Box 3800
San Antonio, TX 78284
(512) 733-2526

Honors Undergraduate Research Training Fellowships of the Minority Access to Research Careers (MARC) Program

Contact: Marvin H. Bernstein
Biology Department
New Mexico State University
Box 3AF
Las Cruces, NM 88003
(505) 646-3823

Math Anxiety Weekend Workshop/Training

Contact: George Weston/Tina Goldberg
Southwestern College
900 Otay Lakes Road
Chula Vista, CA 92010
(619) 421-6700

Math Articulation Guide

Contact: Tina Goldberg/Cristina DiSalvo
Southwestern College
900 Otay Lakes Road
Chula Vista, CA 92010
(619) 421-6700

Math Brochures

Contact: Adriana Barrera
Laredo Junior College
W. End Washington Street
Laredo, TX 78040
(512) 722-0521

Math Intervention Project

Contact: Cristina DiSalvo
Southwestern College
900 Otay Lakes Road
Chula Vista, CA 92010
(619) 421-6700

Math is Easy, Math is Fun (a videotape)

Contact: Raul A. Besteiro, Jr.
Brownsville Independent
School District
1102 E. Madison
Brownsville, TX 78520
(512) 546-3101

Math Tutorial Program

Contact: Tina Goldberg/Cristina DiSalvo
Southwestern College
900 Otay Lakes Road
Chula Vista, CA 92010
(619) 421-6700

Math? Who Needs It? (a videotape)

Contact: Glenn Wallace/Mike Gonzalez
Texas Southmost College
80 Fort Brown
Brownsville, TX 78520
(512) 541-1241

Mathematics, Engineering, Science Achievement (MESA)

Contact: Richard Sartee/Lloyd Cunaway
University of California, Berkeley
Lawrence Hall of Science
Berkeley, CA 94720
(415) 642-5064

Mathematics Festival

Contact: Roger Knowlton
Imperial Valley College
P. O. Box 158
Imperial, CA 92251
(619) 352-8320

Mathematics Instruction Through Videotapes

Contact: Glenn Wallace
Texas Southmost College
80 Fort Brown
Brownsville, TX 78520
(512) 541-1241

Mathematics Placement Tests

Contact: Alejandro Perez
Laredo Junior College
W. End Washington Street
Laredo, TX 78040

Minority Biomedical Research Support Program

Contact: Dr. Alonzo C. Atencio
or Margaret Garberina
School of Medicine
University of New Mexico
Student Affairs, Room 106
Albuquerque, NM 87131
(505) 277-2728

Minority Engineering Program

Contact: Alfonso Lopez
Texas A&I University
Campus Box 121
Kingsville, TX 78363
(512) 595-2778

Minority Engineering Program

Contact: Irma Y. Lozano
School of Engineering/MEP
University of California,
Los Angeles
3161 Engineering 1
Los Angeles, CA 90024
(213) 206-6493

Minority Enrichment Seminar in Engineering Training

Contact: G. F. Paskusz
University of Houston,
University Park
4800 Calhoun
Houston, TX 77004
(713) 749-1139

Modified Self-Paced Courses:
MA 315/Beginning Algebra and
MA 316/Intermediate Algebra

Contact: Adriana Barrera/Kay Kriewald
Laredo Junior College
W. End Washington Street
Laredo, TX 78040
(512) 722-0521

Modules for MA 319-Concepts of Elementary Mathematics

Contact: Adriana Barrera
Laredo Junior College
W. End Washington Street
Laredo, TX 78040
(512) 722-0521

Open Entry, Open Exit Math Courses for Delivery in Math Laboratory

Contact: Jean Roland
Arizona Western College
P.O. Box 929
Yuma, AZ 85364
(602) 726-1000

Parent Brochure

Contact: Raul A. Besteiro, Jr.
Brownsville Independent
School District
1102 E. Madison
Brownsville, TX 78520
(512) 546-3101

Parent Survey

Contact: Raul A. Besteiro, Jr.
Brownsville Independent
School District
1102 E. Madison
Brownsville, TX 78520
(512) 546-3101

Pre-Engineering Summer Workshops for Women and Minorities

Contact: Morris Farr
College of Engineering
The University of Arizona
Tucson, AZ 85721
(602) 621-2446

Pre-Freshman Engineering Program for Minority Students

Contact: Manuel Berriozabal
University of Texas, San Antonio
San Antonio, TX 78285
(512) 691-5530 or 691-4496

Professional Development Program

Contact: Robert E. Fullilove, III
University of California, Berkeley
230 B. Stephens Hall
Berkeley, CA 94720
(415) 642-2115

Project PLUS Math

Contact: Connie Cook
Arizona Math Project
Department of Mathematics
The University of Arizona
Tucson, AZ 85721
(602) 621-2202

Project RISE LA (Science)

Contact: Janet Thornber
Office of Academic
Interinstitutional Programs
University of California,
Los Angeles
1332 Murphy Hall
Los Angeles, CA 90024
(213) 825-3295

Promotion and Awareness of Careers in Engineering Program

Contact: Alvin D. Rivera
Mexican American Engineering Society
955 L'Enfant Plaza, SW; Suite 4000
Washington, DC 20024
(202) 488-6044

San Antonio Independent School District
Biomedical Program

Contact: Rosemary Castro
Fox Tech High School
637 N. Main
San Antonio, TX 78205
(512) 226-5103

South Texas Engineering, Math, and Science

Contact: Alfonso Lopez
Texas A&I University
Campus Box 121
Kingsville, TX 78363
(512) 595-2778

Southwest Resource Center for Science
and Engineering

Contact: Richard J. Griego
University of New Mexico
2101 Mesa Vista Hall
Albuquerque, NM 87131
(505) 277-3641

Study of Improvement in the Quality,
Availability, and Usage of the Mathematics
Tutoring Service

Contact: David M. Pettes
Cochise College
Rt. 1, Box 100
Douglas, AZ 85607
(602) 364-7943

Study of the Effectiveness of Cochise College Programs in Meeting the Math Education Needs of Technology Majors

Contact: Marla J. Colvin
Cochise College
Rt. 1, Box 100
Douglas, AZ 85607
(602) 364-7943

Survey of Students in Math and Science Courses

Contact: Cristina DiSalvo
Southwestern College
900 Otay Lakes Road
Chula Vista, CA 92010
(619) 421-6700

Texas Alliance for Minorities in Engineering, Inc.

Contact: John S. Robottom
Office of the Dean
College of Engineering
University of Texas, Arlington
Box 19019
Arlington, TX 76019
(817) 273-2571

The Arizona Math Project

Contact: Connie Cook
The University of Arizona
Tucson, AZ 85721
(602) 621-2202

UCLA Math Project

Contact: Susie Hakansson
Office of Academic
Interinstitutional Programs
University of California,
Los Angeles
1332 Murphy Hall
Los Angeles, CA 90024
(213) 825-2531

University of Houston Transitional
Engineering Summer School

Contact: G. F. Paskusz
University of Houston,
University Park
4800 Calhoun
Houston, TX 77004
(713) 749-1139

Women in Science and Engineering Office

Contact: Jo Ann Troutman
The University of Arizona
Modern Languages, 263
Tucson, AZ 85721
(602) 621-7339

APPENDIX B

RESOURCE ORGANIZATIONS

American Association for the
Advancement of Science

Contact: Shirley M. Malcolm
Office of Opportunities in Science
1333 H Street, NW
Washington, DC 20005
(202) 326-6400

Border College Consortium

Contact: Albert Besteiro
Texas Southmost College
80 Fort Brown
Brownsville, TX 78520
(512) 541-3528

Math Science Network
Math/Science Resource Center

Contact: Jan MacDonald
c/o Mills College
Oakland, CA 94613
(415) 430-2230

Mexican American Engineering Society

Contact: Alvin Rivera
955 L'Enfant Plaza, SW, Suite 4000
Washington, DC 20024
(202) 488-6044

National Action Council for Minorities and Engineering, Inc.

Contact: Ronnie Denes
3 West 35th Street
New York, NY 10001
(212) 279-2626

Society for the Advancement of Chicanos and Native Americans in Science

Contact: J. V. Martinez
P.O. Box 30040
Bethesda, MD 20814
(301) 353-5820

APPENDIX C

MATH/SCIENCE PROGRAM SURVEY

Project Title: _____

Director's Name _____

Institution: _____

Address: _____

_____ Zip _____

Telephone: (___)_____

1. For which student ethnic group is this program mostly targeted?

   _____ Mostly Hispanics
   _____ Mostly Blacks
   _____ Mostly Native Americans
   _____ Mostly Whites
   _____ Other: _____

2. What level of students does this program address?

   _____ Four-year college students
   _____ Two-year college students
   _____ High school students
   _____ Junior high school students
   _____ Elementary school students
   _____ Both college and school students
   _____ Other: _____
   _____

3. How long has this project been in existence?

   _____ Less than one year
   _____ 1-2 years
   _____ 3-4 years
   _____ 5-6 years
   _____ Over 6 years; list number of years: _____

BEST COPY AVAILABLE

4. How is the project funded?

_____ 100% Institutional funds
_____ 100% Private foundation funds; list foundation:
_____

_____ 100% Federal funds; list federal funds:
_____

_____ Combination of funding sources; list sources:
_____

_____ Other: _____
_____

5. List the objectives for the project.

6. Does this program include training for any of the following? (Check all that apply.)

___ College teachers
___ College counselors
___ Precollege teachers
___ Precollege counselors
___ Parents
___ College administrators
___ Precollege administrators

7. Please answer the following about the students in this project:

a) Number of total students served: _____
b) Number of Hispanic students served:

Hispanic males = _____
Hispanic females = _____

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8. List and briefly describe the project activities conducted for Hispanic students. Please include selection criteria for program participants, recruitment and retention strategies used, curriculum design, and outcomes expected from project.

9. Have you collected any data about your project (i.e., studies about Hispanic students in the project, including demographics, factors which influence course-taking behavior, factors which influence student success, etc.)? _____ Yes _____ No

   If yes, what are the major findings you have derived about Hispanic students in your project?

10. What set of elements do you feel make the project successful for Hispanic students (i.e., use of role models, bilingual instruction, faculty contact with students, etc.)?

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11. What process do you use to evaluate the project?

a) What evaluation model (if any) is followed?

b) Who is involved in the evaluation process?

c) What kind of data is collected?

d) What is done with the data?

12. Have you conducted follow-ups on the Hispanic students who went through the project? _____ Yes _____ No

If yes, what did the data demonstrate about these students?

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13. In your opinion, what kinds of programs need to be developed in order to help Hispanic males and females participate and succeed in math and science career fields?

14. Estimated yearly project costs:
    Direct funds: _____
    Indirect funds: _____

15. Has the project been institutionalized by "regular" programs of your institution? _____ Yes _____ No

16. Do you have additional information you wish to share about this project? _____ Yes _____ No

    If yes, please attach additional information to survey.

THANK YOU FOR YOUR COOPERATION IN COMPLETING THIS SURVEY.

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MacCorquodale, P. (1983, May). Social influences on the participation of Mexican American women in science (N.I.E. Final Report 6-79-011). Tucson, AZ: University of Arizona.

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ABOUT THE AUTHOR

Laura I. Rendón is a Research Associate of the National Institute of Education's Program on the Dissemination and Improvement of Practice. Dr. Rendón is the former Director of The Math Intervention Project funded by The Ford Foundation for The Border College Consortium, a group of six community colleges located along the 2,000-mile United States-Mexico border. Dr. Rendón has extensive experience with issues pertaining to Hispanics, minorities, and low socioeconomic status students in higher education.

Dr. Rendón is the author of numerous publications pertaining to Hispanic students in mathematics and science courses, the effectiveness of basic skills models, factors which impact persistence and transfer rates of community college students, and the recruitment and retention of minority students. Dr. Rendón's work has been featured at several national higher education conferences. An active proponent of improving access and educational opportunities for Mexican Americans, Dr. Rendón has been a developmental studies director, counselor, and faculty member at Laredo Junior College; a minority student recruiter at The University of Michigan; a consultant to The Office of Bilingual

Education and Minority Affairs; and a Title III external evaluator.

A native of Laredo, Texas, Dr. Rendón obtained her precollege education in Laredo schools and attended Laredo Junior College. She holds a PhD in higher education administration from The University of Michigan (Ann Arbor), a Master of Arts degree from Texas A&I University (Kingsville), a Bachelor of Arts degree from The University of Houston (Texas), and an Associate of Arts degree from San Antonio College (Texas).